



T21 Thermal Differential Switch

General Instructions

The T21 Point Level Switch is a state-of-the-art in liquid level and interface measurement and control. Level detection is accomplished by using a high-resolution thermal differential technique. The sensor wetted parts are of durable 316L series stainless steel, all-welded construction and contain no moving parts. The switch is easy to install and adjustable providing reliable, low-maintenance performance in the most demanding applications.



NOTE: If you suspect that a product is defective, contact the factory or the SOR® Representative in your area for a return authorization number (RMA). This product should only be installed by trained and competent personnel.

*Design and
specifications are
subject to change
without notice.*

*For latest revision,
go to **sorinc.com***

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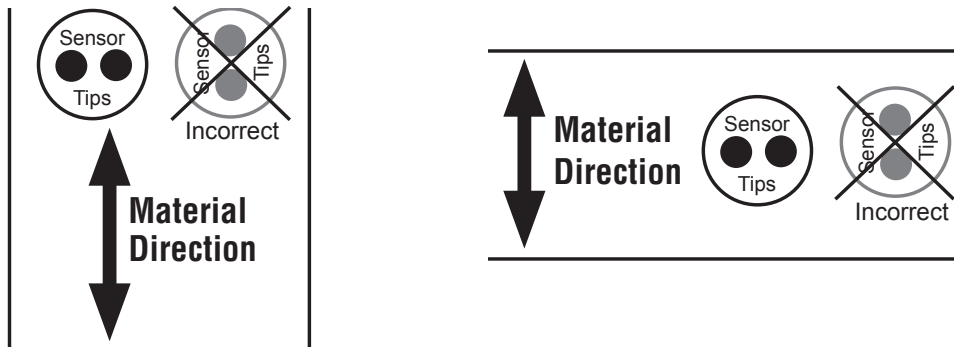
Mechanical Installation

The T21 has a 3/4-inch MNPT mount (standard), designed for easy installation through a threaded port.

- Conduit is recommended for all wiring to the switch.
- Due to the pipe thread mounting, it may be necessary to make a trial fit, add or remove teflon tape or other pipe thread sealant and reinstall to achieve a satisfactory seal with the sensor properly oriented.
- Proper orientation is marked on the switch body for reference.
- It is generally recommended that the sensor tips be located at 1/4 of the pipe's inside diameter (I.D.) assuming pipe is full. (See **A**)

Level Application

- The switch body **MUST** be oriented with the two sensor tips aligned parallel to the level being detected. (Disregard for top mount installation.)



Flow Application

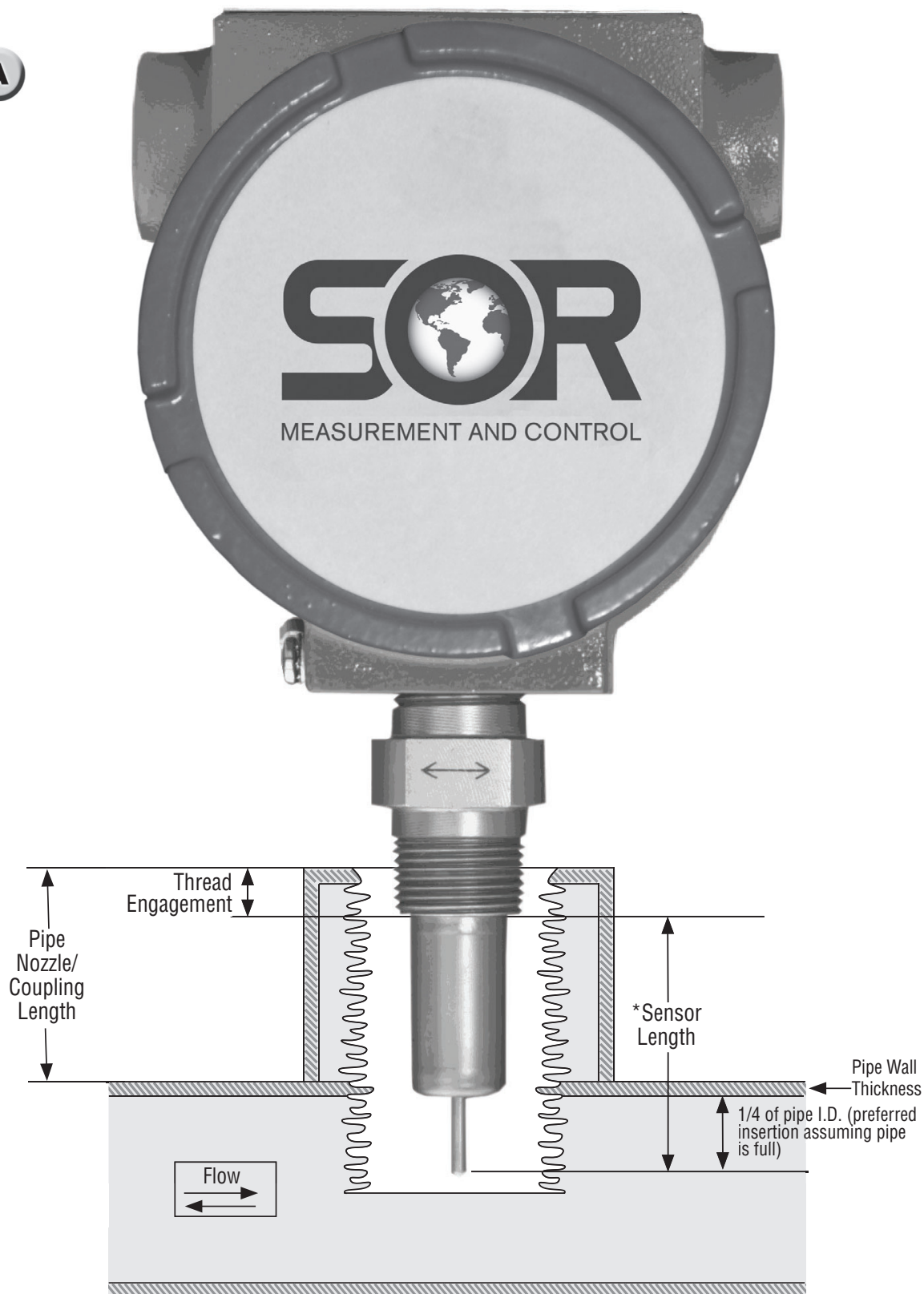
- The switch body **MUST** be oriented with the two sensor tips aligned perpendicular to the flow being detected.



*For level and flow applications the material you are monitoring **MUST** contact the two sensor tips at the same time .*



Use a 1-1/8", open-end wrench to tighten at the HEX flats of the MNPT of a standard switch. Do not use the instrument head to tighten the switch to the mounting port. Rotation of the instrument head with respect to the sensor body may cause internal wiring damage.

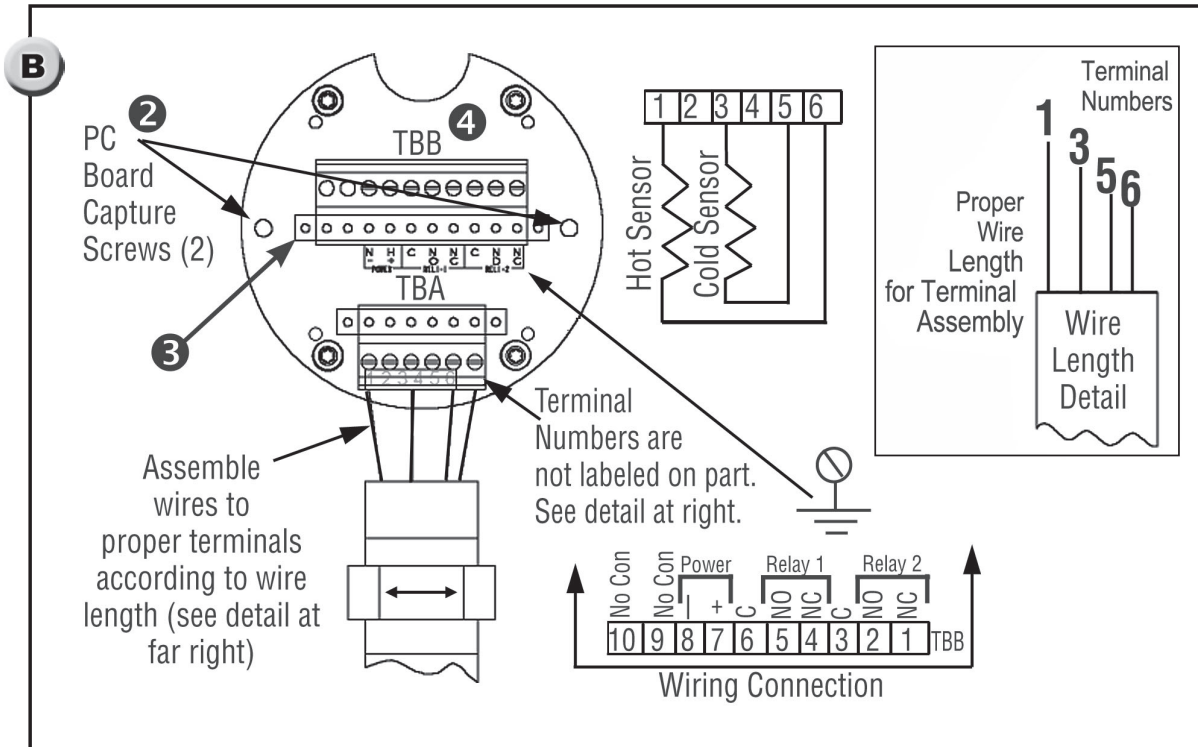
A

Unit can be mounted above or below pipe. Mounting on top of pipe is displayed above.

$$\begin{aligned} \text{*Sensor Length} = & \text{Nozzle/Coupling length} \\ & + \text{Pipe wall thickness} \\ & + 25\% \text{ of pipe I.D.} \\ & - \text{Thread engagement} \end{aligned}$$

Electrical Installation

- ❶ Remove the instrument enclosure lid by unscrewing in a counterclockwise direction.
- ❷ Loosen the two, board-retaining captured screws.
- ❸ Remove the printed circuit board by grasping the transformer on the center of the board and, while rocking gently back and forth, pull firmly outward.
- ❹ Connect power and alarm relay wiring to Terminal Block TBB as shown in **B**.
- ❺ Reinstall the switch electronics and tighten the retention screws.



NOTE: Connections to sensors are factory installed and should not be disconnected in the field.

NOTE: For 24 VDC operation (factory prepared), connect +24 VDC to TBB7 and 24 VDC return to TBB8. For 115 VAC or 230 VAC operation, there is no polarity.

NOTE: Connect ground wire to the ground screw located in back of instrument enclosure. A ground wire must be attached to the ground screw located inside and on the back of instrument head for proper operation.

Setup and Operation

- ❶ Remove the instrument head cover. Turn counterclockwise to expose the electronics.
- ❷ Turn on power at its source.
- ❸ Observe that either the red or green LED illuminates.
- ❹ If neither lamp illuminates, refer to the troubleshooting section.

L.E.D. and Relay Status Logic (Fail-Safe)

The L.E.D.s (L1-Red and L2-Green) are an indication of the sensor status (dry or wet) and are not affected by the position of the fail-safe jumper J-2. The fail-safe jumper J-2 changes the relay activation status allowing the user to select the fail-safe, power-off condition most appropriate to the application. Refer to **C** and **D**, showing the logic conditions between the sensors, L.E.D. lights, relay coil and contacts for each position of the fail-safe jumper J-2.

Pre-Operational Check

If the switch is installed and product level is below sensor level, or there is no flow, use the following procedure to verify preliminary operation.

Normal Operation (as set at the factory) The switch comes configured from the factory with the following operation with the J-2 jumper in the B position. (See **E**, page 7)

C	Level Sensor Status	L1 Red LED	L2 Green LED	Relay Coil Status	Relay Contact Status
	Dry or Lower Therm. Differential Fluid (i.e. hydrocarbons)	ON	OFF	Energized	oNC oNO
	Wet or Higher Therm. Differential Fluid (i.e. water)	OFF	ON	De-energized	oNC oNO

Alternate Operation (Field Selectable) The relay logic may be reversed by moving the J-2 jumper to position A. (See **E**, page 7)

	Level Sensor Status	L1 Red LED	L2 Green LED	Relay Coil Status	Relay Contact Status
	Dry or Lower Therm. Differential Fluid (i.e. hydrocarbons)	ON	OFF	De-energized	oNC oNO
	Wet or Higher Therm. Differential Fluid (i.e. water)	OFF	ON	Energized	oNC oNO


Normal Operation (as set at the factory) The switch comes configured from the factory with the following operation with the J-2 jumper in the B position. (See **F**, page 9)

D	Flow Sensor Status	L1 Red LED	L2 Green LED	Relay Coil Status	Relay Contact Status
	No flow or flow below set point	ON	OFF	Energized	oNC oNO
	Flow or flow above set point	OFF	ON	De-energized	oNC oNO

Alternate Operation (Field Selectable) The relay logic may be reversed by moving the J-2 jumper to position A. (See **F**, page 9)

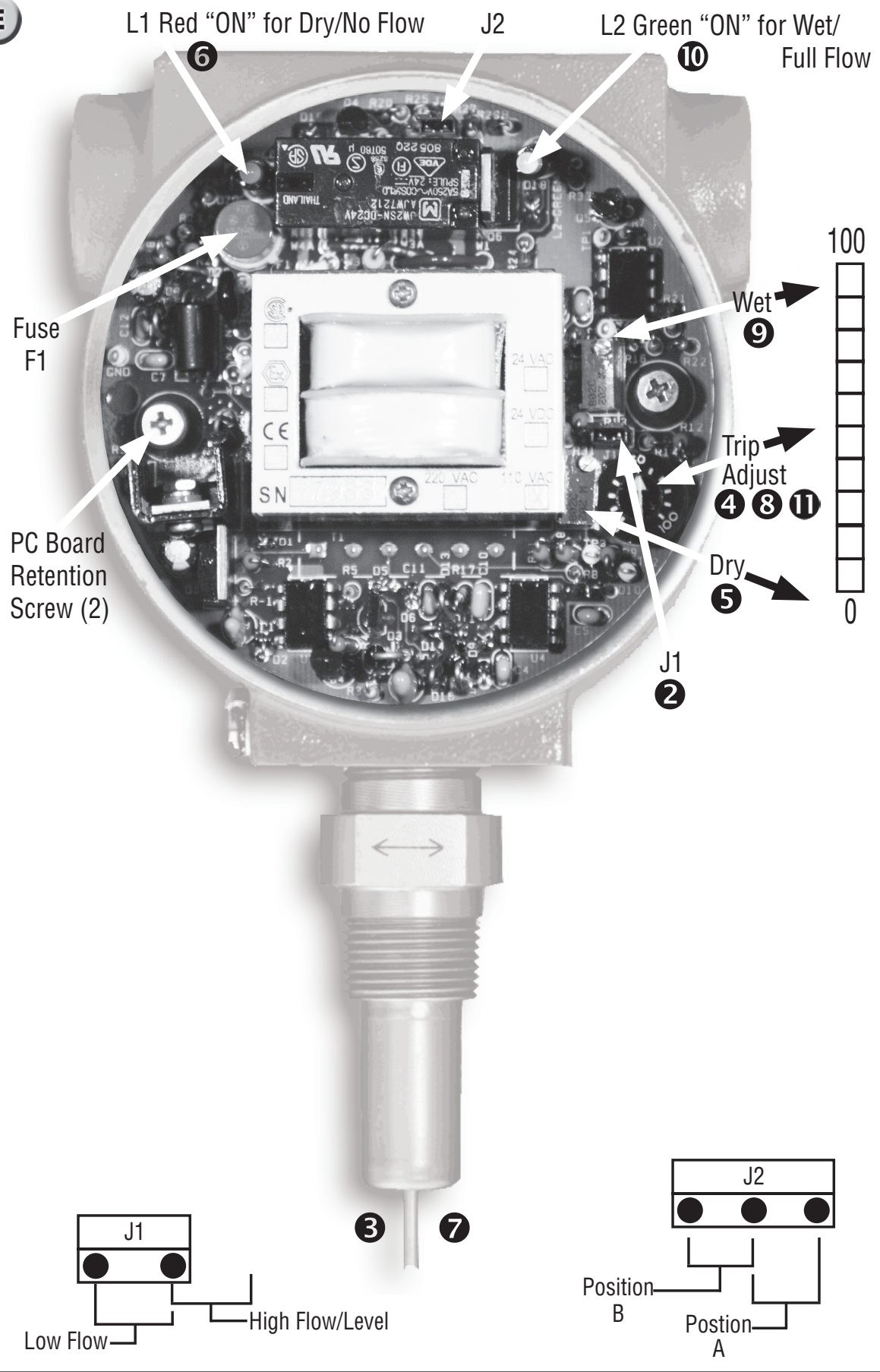
	Flow Sensor Status	L1 Red LED	L2 Green LED	Relay Coil Status	Relay Contact Status
	No flow or flow below set point	ON	OFF	De-energized	oNC oNO
	Flow or flow above set point	OFF	ON	Energized	oNC oNO

Calibration for Level Switches

For optimum operation, calibration must be accomplished at actual process temperature and pressure conditions. Using  as a location guide, adjust the system as follows:

- ➊ Remove the instrument enclosure lid by turning it counterclockwise.
- ➋ Apply power to the T21. Allow 5 minutes for the T21 to warm up. Verify J1 jumper is in the level position (Factory Default).
- ➌ Ensure that the tank liquid level is below the probe sensor tips and the tips are dry.
- ➍ Set the trip adjust potentiometer to zero fully counterclockwise (ccw).
- ➎ Adjust the dry adjust pot so that the red LED just illuminates. This is a 25-turn pot. If the green LED is on, turn the pot counterclockwise (ccw). If Red LED is on, turn the pot clockwise (cw).
- ➏ Toggle the dry adjust pot back and forth until the switching point is well defined. Leave the red LED illuminated. To ensure best definition/performance, wait approximately 30 seconds between toggles.
- ➐ Raise the level of the liquid to be detected until the probe/sensor tips are submerged and wet (covered).
- ➑ Set the trip adjust pot to 100 (fully clockwise).
- ➒ Adjust the wet adjust pot so that the green LED just does illuminate. This is a 25-turn pot. If the green LED is on, turn the pot clockwise. If the red LED is on, turn the pot counterclockwise.
- ➓ Toggle the set adjust pot back and forth until the switching point is well defined. Leave the green LED illuminated. To ensure best definition/performance, wait approximately 30 seconds between toggles.
- ➑ Adjust the trip adjust pot to 80 and the calibration is complete.

E

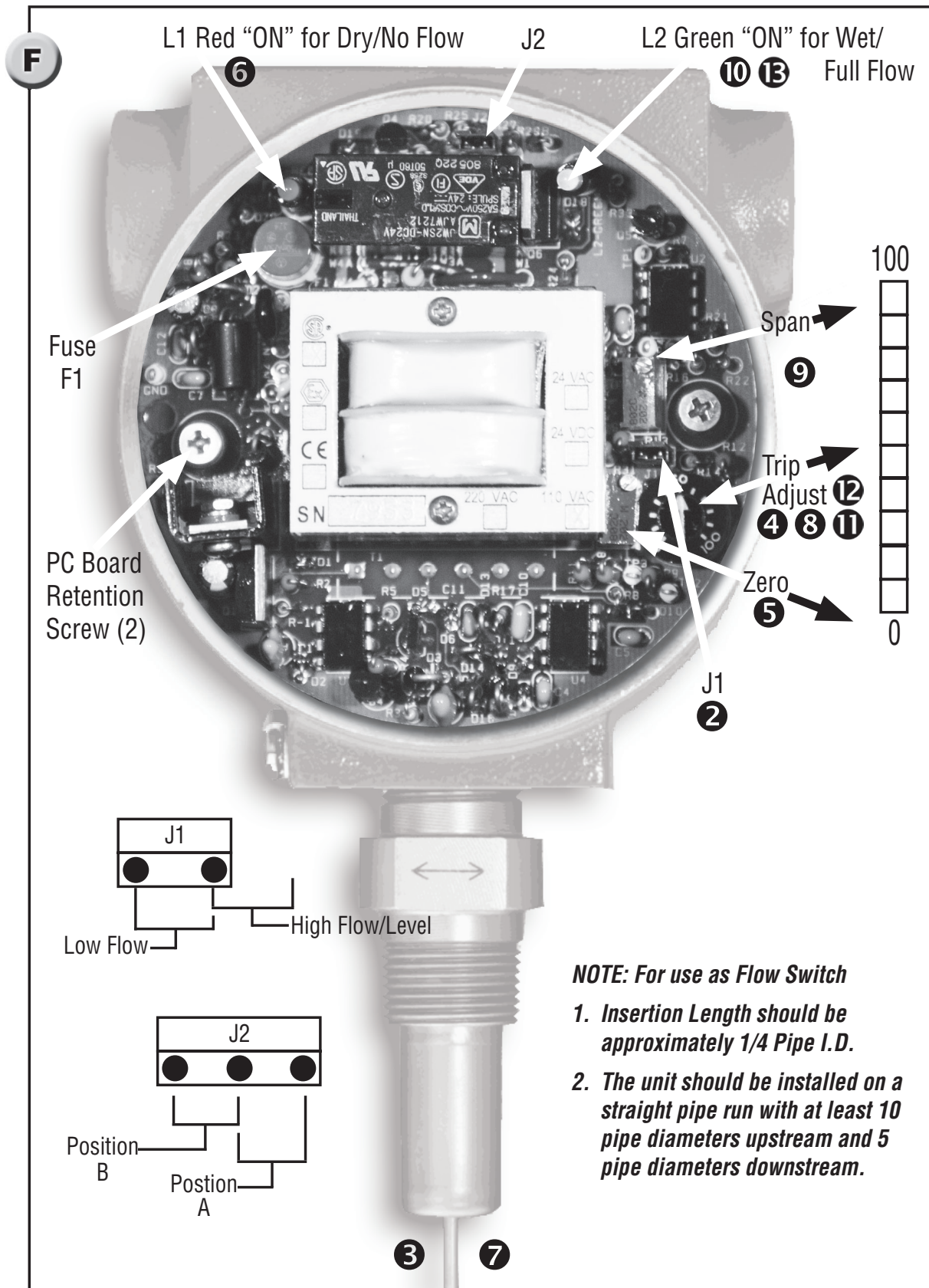


Calibration for Flow Switches

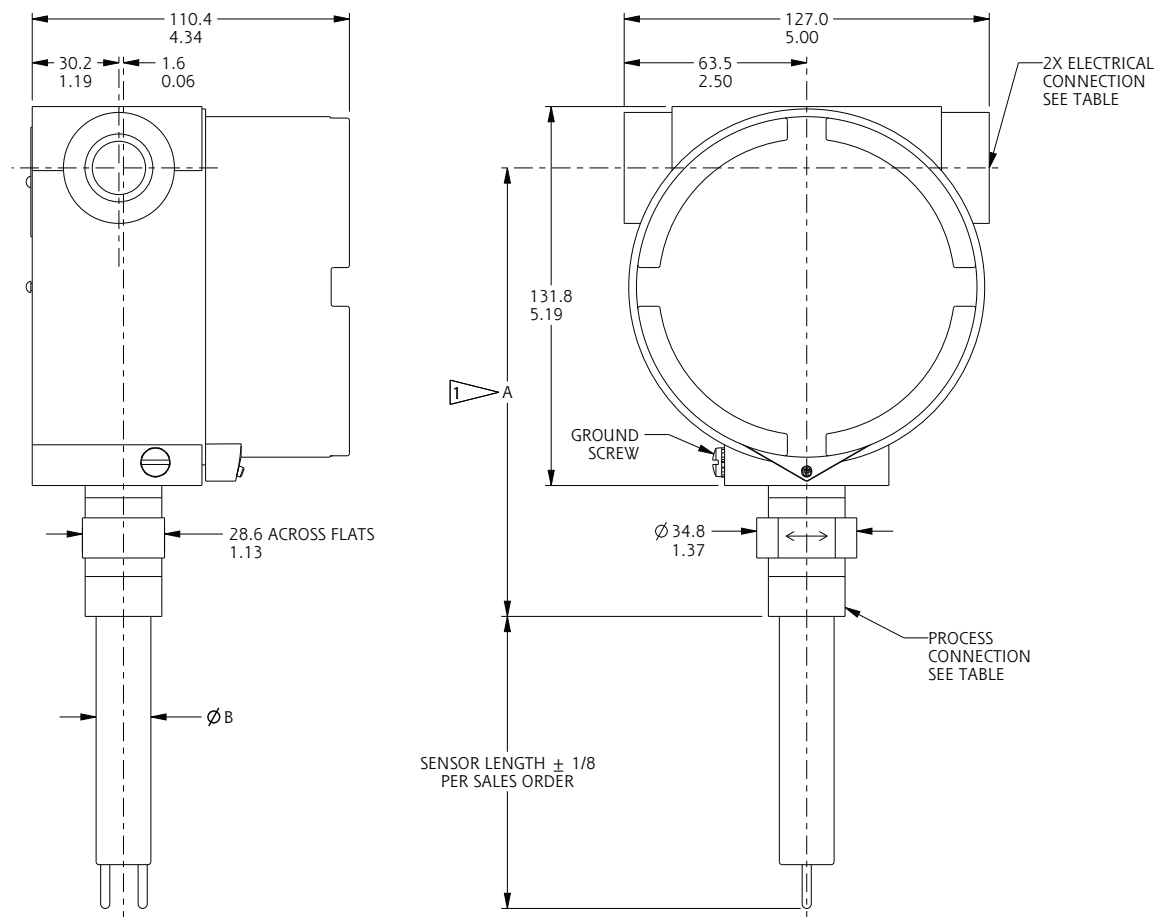
Using **F** as a location guide, adjust the system as follows:

- ➊ Remove instrument enclosure lid by turning it counterclockwise.
- ➋ Apply power to the T21. Allow 5-minute warm-up. Verify J1 jumper is in low flow setting if air/gas flow rate is approximately 20 f/s and below (factory default). For liquid or high air/gas flow rates, the jumper should be in high flow/level position.
- ➌ Ensure that the pipeline is filled with fluid and at no or minimum flow.
- ➍ Set trip adjust potentiometer to zero fully counterclockwise (ccw).
- ➎ Adjust the no-flow pot so that red LED just illuminates. This is a 25-turn pot. If green LED is on, turn pot counterclockwise (ccw). If the red LED is on, turn the pot clockwise (cw).
- ➏ Toggle no-flow pot back and forth until the switching point is well defined. Leave red LED illuminated. To ensure best definition/performance, wait approximately 30 seconds between toggles.
- ➐ Adjust liquid or gas flow to maximum velocity. Ensure that flow is homogenous, constant and free of bubbles if a liquid.
- ➑ Set trip adjust pot to 100 (fully clockwise).
- ➒ Adjust the full-flow pot so the green LED just illuminates. This is a 25-turn pot. If green LED is on, turn pot clockwise. If red LED is on, turn the pot counterclockwise.
- ➓ Toggle full-flow pot back and forth until switching point is well defined. Leave green LED illuminated. To ensure best definition/performance, wait approximately 30 seconds between toggles.
- ➔ If the switch is to be used for flow - no flow, set the trip adjust pot to 50 and go to step 14.
- ➕ A more exact flow rate setting may be achieved by establishing flow at a desired rate with a separate flow meter and proceeding to step 13, to establish trip point.
- ➖ Adjust the trip adjust pot to obtain a trip as exhibited by a LED illumination. If a trip on decreasing flow is desired, set for red LED illumination. If a trip on increasing flow is desired, set for green LED illumination.
- ➗ Verify the switch will reset by returning actual product flow to maximum or minimum flow rates.

NOTE: This adjustment may be done for tripping points between 10% and 90% of the span from no flow to max flow.



Dimensions



1 DIMENSION APPROXIMATE AND BASED ON A FIVE THREAD ENGAGEMENT

*Dimensions are for reference only.
Contact the factory
for certified drawings
for a particular model number.*

PROCESS CONNECTION	A	$\varnothing B$
3/4 NPTM	156.0 6.14	19.1 0.75
1 NPTM	175.0 6.89	19.1 0.75

Linear = mm/inches

Drawing 0390596

Cleaning

The probe may be cleaned by soaking, spraying solvents or detergent and water onto the sensor tubes, or by ultrasonic cleaning.

Lime deposits can be safely removed by soaking in 20% hydrochloric acid. Warming to 150°F is permissible to speed this process.

For unusual cleaning problems, contact the SOR factory to determine the exact materials of construction and chemical compatibility before using strong acids or unusual cleansers. Do not sandblast or scour the sensing probes with abrasive cleaners. The sensing probes could be damaged by abrasives.

Troubleshooting

General Information

- Each unit is different. Settings may not be identical from unit to unit
- Moving the trip adjust pot closer to 100 produces
 - Slower “On” response
 - Faster “Off” response
- Set span at maximum possible flow rate (as far above the span setting as possible)
- Once again, the catalog J1 jumper settings are a starting point only

What do I do if...

... my zero or span is shifting during calibration?

The probes have likely not warmed up sufficiently. Apply power, place the probes in the zero state process, and wait for 5 minutes. (In dry air, the heated probe may be too hot to touch.)

... my setpoint has shifted shortly after calibration?

The probes were likely not allowed to warm sufficiently during calibration. Apply power, place the probes in the zero state process, wait for 5 minutes, and repeat the calibration process. In dry air, the heated probe should be hot to the touch.

... I cannot get the red light to illuminate when turning the zero pot?

- Make certain the heated probe is heating properly.
- Make certain the Trip Adjust pot is in the fully counter-clockwise position
- Change J1 jumper position and try again
- If calibrating for liquid flow, try performing the zero function in dry air
- Reverse Hot and Cold sensor wires and retry

... wire is the proper length for terminal assembly?

- Reverse the wires: 1 and 3

... I cannot get the green light to illuminate when turning the span pot?

- Make certain the heated probe is heating properly.
- Make certain the Trip Adjust pot is in the fully counter-clockwise position
- Change J1 jumper position and try again
- If calibrating for liquid flow, try performing the zero function in dry air
- Reverse Hot and Cold sensor wires and retry

- Turn the unit around so that the other side of the probes faces the flow
 - RTD's have a front and a back. Sometimes turning the probes around so that the other side is facing the flow will produce better results

... *the unit calibrated well but at some later point my setpoint has shifted?*

- Make sure the process has not changed
- Changes in the thermal properties of the fluid will affect set point accuracy
- Check the probe tips for uneven build-up
 - If the build up on one probe (usually the hot) is much greater than the other then the thermal differential relationship is compromised.
- Check inside of pipe for build-up
 - If the process sticks and builds-up on the inside of the pipe, the diameter can get smaller causing a change in process velocity.
- If all else fails, check the integrity of the sensor and boards (for step-by-step instructions see the Thermal Differential Point Switch_1024 General Instruction Manual on sorinc.com)

Power and Continuity Verification

- ① Turn the power off to the T21 Switch.
- ② Remove the instrument enclosure cover.
- ③ Loosen the PC board capture screws. (See **B**, page 4)
- ④ Unplug the PC board from the instrument enclosure by pulling straight out on the transformer.
- ⑤ Reapply power and verify correct voltage at pins 7 (positive for DC) and 8 (negative for DC) of TBB. (See **B**, page 4)
- ⑥ If voltage is correct, verify the fuse (F1) on the PC board is not blown. (See **F**, page 9)
If fuse is not blown, proceed to Sensor/Electronics Functionality verification step 2.
- ⑦ If fuse is blown, replace with the appropriate fuse.

Sensor/Electronics Functionality Verification

- ① Turn the power off to T21 Switch.
- ② Allow a 5-minute cool down.
- ③ Measure the resistance of each RTD at pins 1 and 6 of TBA (See **B**, page 4) for the first RTD, and pins 3 and 5 of TBA for the second RTD. These resistances should be 110 ± 10 ohms (with sensors at approximately 70°F) and within 5% of each other in value.
- ④ Measure the insulation resistance between pin 1 of TBA and the case of the Switch. It should be greater than 20 megohms.
- ⑤ If the switch sensor assembly resistances are not as specified above, the switch sensor assembly must be replaced.
- ⑥ If the switch sensor assembly resistances are as specified, the switch PC board must be replaced.



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